

Environmental Monitoring Programs

2002 Olympic Winter Games
Salt Lake City, Utah

Prepared for:
**ERM Italy and
The Torino Organising Committee**

February 2003

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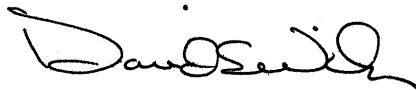
Environmental Monitoring Programs

*2002 Olympic Winter Games
Salt Lake City, Utah*

February 26, 2003



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News Release on Olympics Cleaner and Greener Program

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Reclamation Plan 2002 Olympic Winter Icon

Reclamation Revision

Environmental Resources Management's (ERM) Italy office requested information and data related to environmental monitoring conducted during the 2002 Olympic Winter Games held in Salt Lake City, Utah. The Utah Department of Environmental Quality (UDEQ) initiated an integrated environmental monitoring program prior to the Games to collect data on air quality, water quality and waste management. The program enlisted the cooperation of non-regulatory stakeholders including several functional groups within the Salt Lake Organizing Committee (SLOC), with the Environment Function being the lead. Other groups that participated in gathering or providing environmental monitoring data presented in this report include the local power company (PacifiCorp), Leonardo Academy, Nelson Laboratories, local wastewater treatment plants, and Wasatch Energy Systems, a local solid waste recycling company.

Environmental monitoring information related to the Games was gathered for air quality, surface water quality, solid and hazardous waste generation and recycling, wastewater, potable water, energy consumption and habitat considerations. Generation potentials were estimated for many of these programs prior to the Games, and these estimates were used for planning and permitting purposes. Where pre-Games estimation calculations exist, they have been included in this report. In addition to conventional environmental monitoring programs, monitoring of venue environmental compliance was performed through daily, weekly or bi-weekly inspections. Environmental spills¹ and incidents² were also reported, tracked and mitigated. Information on these two programs is included in Section 2.8 of this report.

This report provides information on environmental monitoring protocols in terms of who was responsible for data collection and how and where the monitoring was performed. The monitoring data are presented, where possible, in table format in the text of this report and/or in appendices. Discussions and interpretations of the monitoring results are also included. Section 3.0 of the report provides recommendations from ERM's Salt Lake City office to ERM Italy and TOROC on lessons learned and suggestions for development and implementation of a successful environmental monitoring program for the 2006 Olympic Winter Games.

A general location map of the Salt Lake City venues is included as Figure 2-1. Table 2-1 provides information about each venue including corresponding event(s), geographic location, location by city/county, elevation, number of event days and spectator capacity.

2.1

AIR EMISSIONS

The Utah Department of Environmental Quality (UDEQ), Division of Air Quality (DAQ) monitors air quality on a daily basis as required by the U.S. Environmental Protection Agency (EPA) using EPA approved monitoring equipment. The data are recorded at strategically located monitoring stations and relayed electronically to the DAQ who then carefully review the data. During the winter months, the DAQ operates four monitoring stations in Salt Lake County, one station in Davis County, two stations in Weber County and three stations in Utah County with an

¹ Defined as any unauthorized discharge of oil or other substance that may cause pollution of land, air or water or may be harmful to human health.

² Defined as a potential non-compliance incident, any other threat to the environment or a possible violation. Also any incident that could negatively impact a Contractor or SLOC's reputation.



Source: Salt Lake 2002 – Official Spectator Map

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Figure 2-1
Map of Venue Locations

Drawn By: TMY
Checked By:
Date: 2/19/03

Not to Scale

Project No. U039001.0

**Table 2-1
Venue Information**

| Venue | Event(s) | Geographic Location | City/County | Elevation | # Event Days | Spectator Capacity |
|----------------------------------|---|---------------------|---------------------------|--------------------------------|--------------|---------------------------------------|
| Snowbasin Ski Area (SBA) | Downhill, Slalom, Super-G | Wasatch Back | Huntsville/Weber | Base: 1957 m Summit: 2917 m | 6 | 22,500 |
| Deer Valley Resort (DVR) | Slalom, Freestyle Aerials, Moguls | Wasatch Back | Park City/Summit | Base: 2002 m Summit: 2917 m | 7 | 13,300 |
| Park City Mountain Resort (PCMR) | Giant Slalom, Snowboarding parallel giant slalom, Snowboarding halfpipe | Wasatch Back | Park City/Summit | Base: 2117 m Summit: 3048 m | 6 | 16,500 |
| Soldier Hollow (SHP) | Biathlon, Cross country skiing, Nordic combined | Wasatch Back | Heber/Wasatch | Base: 1670 m Summit: 1793 m | 16 | 15,000 |
| Utah Olympic Park (UOP) | Bobsleigh, Skeleton, Luge, Ski jumping, Nordic combined | Wasatch Back | Park City/Summit | Base: 2097 m Summit: | 16 | 12,500 Track side 20,500 Jump side |
| E Center (ECW) | Ice Hockey | Wasatch Front | West Valley/ Salt Lake | 1250 m | 16 | 8,400 |
| Peaks Ice Arena (PIA) | Ice Hockey | Wasatch Front | Provo/Utah | 1388 m | 13 | 6,300 |
| Salt Lake Ice Center (SLIC) | Figure skating, Short track speed skating | Wasatch Front | Salt Lake/Salt Lake | 1305 m | 14 | 15,600 |
| Utah Olympic Oval | Speed Skating | Wasatch Front | Kearns/Salt Lake | 1425 m | 12 | 4,600 |
| Ice Sheet at Ogden (ISO) | Curling | Wasatch Front | Ogden/Weber | 1460 m | 12 | 1,500 |

extra two stations that only collect PM_{2.5}. The routine monitoring consists of gathering data on PM₁₀ and PM_{2.5}, CO, SO₂ and NO₂. The frequency of monitoring remained the same during the Olympics (daily) as prior to, and after the Games, since increased monitoring for such a short-term event would not yield statistically significant data requiring modification of the State's air quality program.

On a daily basis, the DAQ reviews its air quality monitoring data and issues air pollution advisories to the public. Table A-1 in Appendix A shows the Air Quality Index, Levels of Health Concern and Wood Burning advisories used by the DAQ to convey air quality information to the public.

During, the two weeks prior to the Olympics, a severe inversion settled in the Salt Lake Valley resulting in poor air quality in most of Salt Lake, Davis and Utah Counties. Inversions are unfortunately a fairly common phenomenon in the Salt Lake Valley during the winter months. On February 8, prior to the Opening Ceremonies, a storm front moved into the Salt Lake area and cleared the inversion. The following table presents the advisories issued by the DAQ during the Games. All other days were Green with no health advisory.

Table 2-2 *Utah Division of Air Quality Advisories Issued During the Games*

| Date | Time of Day | DAQ Health Advisory | DAQ Wood Burning Advisory | Affected Counties |
|---------|-------------|-----------------------------|---------------------------|-------------------------|
| 2/11/02 | PM | Applies to sensitive people | Yellow | Salt Lake, Davis |
| 2/12/02 | All day | Applies to sensitive people | Yellow | Salt Lake, Davis, Weber |
| 2/13/02 | AM | Applies to sensitive people | Yellow | Weber |
| 2/16/02 | PM | Applies to sensitive people | Yellow | Salt Lake, Davis |

These data indicate that there was a mild inversion during the first week of the Olympics. The PM_{2.5} and PM₁₀ numeric data for February provided by DAQ appears in Appendix A, Table A-2. The gaseous data results for this period are contained in Appendix A, Table A-3.

Prior to the Games, an estimation of the total Games time air emissions was calculated for the purpose of air quality permitting. The four sources of potential air emissions from SLOC activities included vehicles, portable generators, the Olympic Caldron and fireworks displays.

In conjunction with Utah DAQ, EPA, and the Utah Environmental and Public Health Alliance (EPHA), SLOC developed a Games-time Air Quality Plan. The plan addressed SLOC's transportation impacts and mitigation, as well as other programs that were to improve air quality. Vehicle miles traveled (VMT) were calculated for the 17-day event period. Findings were compared with the projected 2002 vehicle miles traveled along the Wasatch Front and Wasatch Back in order to determine the possible Games related impact.

The roundtrip distance was calculated for downtown Salt Lake City to each venue and Park-n-Ride lot. The calculations used the projected average attendance of each patron group at each venue. The VMT for patron groups at each venue was calculated based on the assumed average roundtrip distance of travel, average day attendance, and anticipated mode of travel. Auto and bus components were calculated. This VMT was multiplied by the number of days the venue would be operating to obtain the total VMT associated with each venue. The total VMT for each venue was added to obtain the anticipated 17-day Olympic period impact.

The VMT for the worst case scenario at each venue was also calculated in a similar manner. The worst case scenario would result in all patron groups driving single occupancy vehicles to each venue. The calculated Games VMT was then compared to the calculated non-Games VMT for the 17-day period. Results are summarized in Table 2-3.

Table 2-3 *Calculated VMT for 17 Day Games Period*

| | |
|-------------------|-------------|
| Non-Olympic VMT | 769,394,826 |
| Worst Case VMT | 119,334,288 |
| Olympic VMT | 34,134,139 |
| Worst Case Impact | 16% |
| Olympic Impact | 4% |

Results indicated that the Games related traffic would add an additional 4% to the existing VMT if no other measures for traffic reduction were taken. SLOC implemented an accredited transportation system, built Park-n-Ride lots and encouraged ticket holders to carpool. These programs were estimated to reduce the worse-case scenario by 71%.

The Olympic VMT was then used to calculate the possible emissions rate for HC, CO and NOx pollutants. The results were based on the projected 2002 Salt Lake area emission rates. The projected data were received from the Wasatch Front Regional Council. Projected emission rates were given

in grams per mile. Based on the calculated auto and bus VMT for the 17-day period the total grams for each pollutant was calculated. A conversion factor of 453.5 grams equals one pound was used to calculate tons of each pollutant. The total was then broken up and reported in an average possible tons per day of each pollutant, which is summarized in Table 2-4.

Table 2-4 ***Calculated Vehicle Emissions***

| Pollutant (tons/day) | Cars | Buses |
|----------------------|-------|-------|
| HC | 2.22 | 0.21 |
| CO | 26.34 | 0.70 |
| NO _x | 2.89 | 0.48 |

Table 2-5 summarizes the theater-wide emissions calculations from the portable generators.

Table 2-5 ***Total Estimated Air Emissions from Portable Generators in Pounds***

| NO _x | CO | PM | HC | SO ₂ | HC |
|-----------------|--------|-------|-------|-----------------|-----|
| 62,594 | 14,269 | 1,402 | 2,091 | 7,877 | 442 |

When the potential emissions were initially calculated, 13 out of 18 venues exceeded the five-ton per year Small Source Exempt limit for NO_x. The venues made adjustments in generator operating plans, such as using the generators for backup rather than primary power, and reducing hours of operation. These actions reduced the potential emissions and allowed SLOC to meet the *de minimis* threshold³ at every venue and thus avoid potentially lengthy air quality permitting. Appendix A, Table A-4 provides a detailed analysis of the emissions by venue. More detailed information on emission calculations can be found in the document “Environmental Compliance at the Salt Lake 2002 Olympic Winter Games and Paralympic Games” prepared by ERM’s Salt Lake City office.

Table 2-6 presents the cauldron emissions calculated using AP-42 emission factors for boilers. The cauldron was fueled by propane and natural gas and was operated at 3 MM btu/hr and 7 MM btu/hr. The cauldron emission also qualified for the Small Source Exemption. A summary sheet for the cauldron emissions appears in Appendix A as Table A-5.

³ To qualify for the air quality Small Source Exemption Registration, the business shall not emit more than 5 tons per year of each of the following pollutants: SO₂, CO, NO_x, PM₁₀, O₃, or VOC’s or emit more than 500 pounds per year of any single hazardous air pollutant (HAP), and emit more than 2000 pounds per year for any combination of HAPs.

Table 2-6 *Total Estimated Air Emissions from Cauldron in Pounds*

| NO _x | CO | PM ₁₀ (total) | SO ₂ | VOC |
|-----------------|--------|--------------------------|-----------------|------|
| 156.01 | 122.26 | 11.26 | 0.95 | 8.34 |

There is no regulatory obligation to consider the emissions (all of which were considered fugitive) from the many fireworks displays throughout the Salt Lake Valley and Park City. However, SLOC chose to do so based on its environmental platform and stated commitment to air quality in Utah. The lack of both established emissions factors (i.e., no AP-42 factors) and definitive information of net explosive weight (NEW) and material constituents made calculating potential emissions a challenging task for CH2M Hill, who provided air quality consulting to SLOC. In preparing these estimates, CH2M Hill assumed that the fireworks consisted of black powder and small amounts of metals as colorants. Emission factors were derived from military munitions. The emissions calculations and assumptions were submitted to DAQ for review and informational purposes. Table 2-7 shows the total estimated emissions from fireworks during the 17 days of the Olympics. More detail for these totals appears in Appendix A, Table A-6.

Table 2-7 *Estimated Air Emissions from Fireworks in Pounds*

| PM ₁₀ | CO | H ₂ S |
|------------------|----------|------------------|
| 1,873.09 | 7,893.58 | 424.39 |

The results of the pre-Games air emissions estimations and the air quality monitoring data collected during the Games indicates that while there was a slight inversion during the first week of the Games, the potential air polluting activities associated with the Games did not appear to significantly impact air quality. The prior planning by SLOC and DAQ to identify potential air polluting activities, such as increased traffic and use of portable generators, helped to develop and implement mitigation measures to reduce air emissions as much as possible. The developments of a complex mass transit system and venue specific generator operating plans are examples of two of the mitigation measures that successfully contributed to an overall reduction in potential air emissions.

Subsequent to the completion of Section 2.1, which used the information provided by DAQ and SLOC, additional emissions information was discovered when researching the estimated increase in energy usage required to host the Games. The Leonardo Academy, based in Madison, Wisconsin, estimated air emissions based on all forms of energy used at

the Games. A more detailed presentation of this information can be found in Section 2.6 Energy Consumption, and in Appendix F.

2.2

WATER QUALITY

The Utah Department of Environmental Quality, Division Water Quality (DWQ) had a broad surface water quality monitoring program in place along the Wasatch Back prior to the Games. Rivers and reservoirs along the Wasatch Back serve as the major drinking water source for cities along the Wasatch Front (Salt Lake, Ogden and Provo). The DWQ routinely monitors the surface water quality along the Wasatch Back for metals, total suspended solids (TSS), conductivity, nutrients including phosphorous (P), total coliform and hydrocarbons. These parameters are important since the mountains along the Wasatch Back once supported a booming mining industry and more recently, the area has experienced a population surge that has brought retail, commercial and residential development. In addition, some of the streams and reservoirs in the area do not meet federal or state water quality standards for nutrients and metals. The Olympic related water quality monitoring program was initiated in the Fall of 2001 and continued through the runoff period into the early Summer of 2002.

The goal of the monitoring program was to protect valuable drinking water sources and provide DWQ with early detection of potential pollution problems associated with Olympic activities. Activities such as venue construction, management of wastewater (sewage), road de-icing (using salt and sand), use of chemicals at the sites (Snomax, P-Tex) and increased traffic volumes were potential sources of pollution. The program was also very interested in monitoring the quality of storm water runoff from the venues.

A team of two Environmental Scientists from DWQ conducted the monitoring. Monitoring was conducted once a month from the Fall of 2001 until the Olympics began, when monitoring was increased to twice per week. After the Olympics, the monitoring frequency reverted back to once a month until the end of June 2002.

The program included 11 sample sites, seven of which were newly established. The DWQ also monitored several of the large Park-n-Ride lots constructed specifically for the Olympic transportation system. The surface waters were sampled for dissolved $\text{NO}_2 + \text{NO}_3$, TSS, dissolved P, Total P, specific conductivity and total coliform. If a visible sheen was detected, then a sample was collected for hydrocarbon analysis. No such samples were ever required or collected at the venue monitoring stations.

Hydrocarbon samples were collected from the sediment ponds located downstream from the large U.S. Route 40 Park-n-Ride. Results indicated that hydrocarbons were present, but at less than the laboratory's quantitative limit⁴.

Table 2-8 outlines the water quality monitoring program developed for the Olympics and provides summary results. A copy of the DWQ's water sampling procedures can be obtained through ERM's Salt Lake City office (note: the volume is very large). Maps of the sample site locations are provided in Appendix B. Tables B-1 through B-10 in Appendix B contain the analytical water quality data. Table B-11 contains data collected from the runoff from the Park-n-Ride lots and Table B-12 shows the data from the one hydrocarbon sample result received to date from the U.S. Route 40 Park-n-Ride lot.

No specific Olympic water quality monitoring program was established along the Wasatch Front since these venues were not located adjacent to flowing streams. The greatest potential for water pollution from the Wasatch Front venues was from parking lots and roads where spills of chemicals or petroleum products could potentially discharge into storm water runoff and drain to streams. Fortunately, this did not happen during the construction, operation or reclamation of the Wasatch Front venues.

The results of the water quality monitoring indicated that there were exceedances of the Utah water quality standards for total phosphorous (P), specific conductivity and total coliform at several monitoring locations during the 17 days of the Olympics. However, it is not clear if the high values are directly related to Olympic activities or merely a reflection of seasonal fluctuations, land use patterns or simply background. Several of the rock formations comprising the Wasatch Back are naturally high in phosphorous. At Park City, additional P can be introduced from fertilizers in runoff from lawns, parks and the golf course. There were exceedances of the P standard of .05 mg/L at all the Wasatch Back locations with the highest being 0.932 collected January 9, 2002 on the right fork of Murnin Creek, east of Highway 224.

The exceedances for specific conductivity (>1200 microsiemens/cm) are likely related to the salting of highways and access roads. It is not clear whether the analytical results indicate normal seasonal fluctuations or should be a cause for concern. A comparison to historic data could not be made since many of the sample site locations were new. It is clear that the

⁴ The quantitative limits are as follows: Benzene 0.5 µg/L; Diesel range organics (nondetect) 1.0 mg/L; ethyl benzene 0.5 µg/L; gasoline range organics (nondetect) 1.0 mg/L; MTBE 1.0 µg/L; Naphthalene 1.0 µg/L; Toluene 0.5 µg/L; m and p-xylene mix 1.0 µg/L; o-xylene 0.5 µg/L

Table 2-8
Surface Water Monitoring Program

| Venue | Sample Site ID | New or Existing Sample Site | Continual or Intermittent Flow* | Discussion of Sample Results |
|------------|---|--------------------------------------|---------------------------------|--|
| SBA | 523247 Dry Creek above sewage lagoons | New | Continual | No exceedances of any parameters before during or after the Games. |
| | 492457 Chicken Spring Creek | Existing Forest Service sample sites | Intermittent | No exceedances prior to or during the Games. One P exceedance during spring runoff in April. |
| | 492458 Bear Hollow Creek | | | No exceedances prior to or during the Games. One slight P exceedance during spring runoff in May |
| UOP | 492527 Rt. Fork Murnin Creek east of Hwy 224 | New | Intermittent | P and specific conductivity exceedances prior to and during the Games. Creek was dry from Late February to June. One total coliform exceedance February 11th. This sample location receives direct storm drain discharge from the highway. |
| | 492529 Rt. Fork Murnin Creek west of Hwy 224 | | | Only flowed on February 18 sample event. Exceeded for P and specific conductivity. |
| | 492530 Lt. Fork Murnin Creek east of Hwy 224 | | | Two P exceedances during the Games and once after. Specific conductivity high all the time. One total coliform exceedance after the Games in early March. This sample location receives direct storm drain discharge from the highway. |
| | 492531 Lt. Fork Murnin Creek west of Hwy 224 | | | One P exceedance during the Games and once after the Games. Specific conductivity exceedances from January through March. |
| | 492532 Murnin Creek at I-80 | Existing | Continual | No exceedances prior to or during the Games. Specific conductivity slightly elevated in March. |
| PCMR & DVR | 492695 Silver Creek above Prospector Square | Existing | Continual | This site not only monitors PCMR and DVR, but all of Park City storm water runoff. Almost every sampling event from August, 2001 through May, 2002 exceeded for P and specific conductivity. Slightly elevated total coliform in August and very high February 18 th . Dead fish noted in creek on February 5 th when the only exceedance was total P at 0.117 mg/L. |

Table 2-8 (continued)
Surface Water Monitoring Program

| Venue | Sample Site ID | New or Existing Sample Site | Continual or Intermittent Flow* | Discussion of Sample Results |
|------------------|--|-----------------------------|---------------------------------|---|
| SHP | 499703 Soldier Hollow Creek at railroad xing | New | Continual | Total P exceeded each sampling event form August, 2001 to June, 2002. One total coliform exceedance in August. Noted a 10-fold increase in total coliform in mid February due to horses stabled near creek. |
| | 499704 Soldier Hollow Creek above road xing and corrals | New | Continual | Total P exceeded each sampling event form February, 2002 to June, 2002. The P concentration matched closely between the two Soldier Hollow sample sites. |
| Park-n-Ride Lots | Sampled sediment pond outfall at various lots. | New | Intermittent | Most of the sampling period no flow from sediment ponds. Very high conductivity at U.S. Rt. 40 south lot on one occasion (February 21). |

* Indicates stream flow was continual or intermittent during sampling period

Murnin Creek samples collected below the Utah Olympic Park and the large Kimball Junction Park-n-Ride lot reflect winter water quality adjacent to a major highway. The samples collected on the east side of the highway were located right below curbside drain drop boxes and therefore contained large amounts of runoff from the highway. From these monitoring points the creeks flow through natural and enhanced wetland areas and then under Interstate 80. The Murnin Creek water sample collected at I-80 showed only one very slight exceedance of specific conductivity (1210 us/cm) on March 21, 2002. It appears that the wetlands acted like a filter to improve the creek's water quality.

The Silver Creek sample was collected below Park City and represents all storm water runoff from Park City and portions of Deer Valley Resort and Park City Mountain Resort. Almost every sampling event from August, 2001 through May, 2002 exceeded the standards for P and specific conductivity. The site had a slightly elevated total coliform count in August and a very high count (>50,000) on February 18. The standard for total coliform is 5000/100 mL. The cause of the high reading is unknown and appears anomalous when studying the entire sample set. One significant event was noted on Silver Creek just prior to the Olympics during the February 5 sampling. Several dead fish were found in the creek. The level of P was 0.117 mg/L, however this was the only exceedance of the water quality standards and likely not the cause of the mortality. The cause remains unknown, but it is thought that a spike in salinity in the creek may have been a contributing factor, although none was detected in the sampling.

Several exceedances of total coliform in the data set are most likely due to land use patterns, i.e., grazing of cattle and horses below the UOP and sheep at Soldier Hollow Park. A spike in the data set at Soldier Hollow during the Games did identify a noteworthy incident. As part of the western theme cultural event at the venue, horses were brought in and stabled for sleigh rides. The corral site unfortunately encompassed the water quality monitoring site. The total coliform count increased from 300/100 mL to 1250/100 mL in just three days. DWQ identified the problem and worked with SLOC, the Venue General Manager, and the Utah Division of Parks and Recreation to minimize impacts to the stream by requiring daily removal of manure and by carefully managing animal access to the stream. The DWQ also established an upstream monitoring site above the corral.

Of particular interest in the data set are the TSS and $\text{NO}_2 + \text{NO}_3$ monitoring results. There were no exceedances of the $\text{NO}_2 + \text{NO}_3$ standard of 5 mg/L at any sample location. The highest TSS sample result was 266 mg/L in Silver Creek on March 21. The overall low TSS sample

results across the Wasatch Back indicate that although significant earth moving and construction was taking place, on-site sediment control was a high priority.

The DWQ also monitored the runoff from the large Park-n-Ride lots. Each lot was built with a sediment pond located directly downslope from the lot. DWQ monitored the outfall from these ponds. There was no flow from the sediment ponds at four of the five large Park-n-Ride lots. The U.S. Route 40 Park-n-Ride lot, with two sediment ponds, was the only site sampled. On February 21, the specific conductivity at the south pond outfall tested very high at 10852 us/cm. The lot managers implemented best management practices for snow removal and salting and the specific conductivity dropped to 1272 us/cm by early March. The sediment ponds were also sampled for hydrocarbons and results to date show their presence below the quantitative limit (Appendix B, Table B-12).

In addition to the water quality monitoring program discussed above, the DWQ in conjunction with SLOC's Venues Compliance Manager, established a specific water quality monitoring program at the Soldier Hollow Park venue for the detection of endotoxin. Endotoxin is found in the snow-making product "Snomax". The use of Snomax along the Wasatch Back was of concern to regulators and the public since not much monitoring information had been gathered on the product and the potential health effect of the product was not clearly understood.

SLOC's Venue Compliance Manager gathered information on Snomax to gain a better understanding of the product and to identify potential negative impacts to human health or the environment. Snomax is an ice-nucleating protein derived from naturally occurring bacteria, *Pseudomonas syringae* (P-syringae). Snomax is made by the fermentation process. The bacteria are harvested, sterilized, filtered, freeze dried, and pelletized. The sterilization ensures that no live organisms remain. Only the protein shell of the organism is used. The protein shell contains endotoxins in the cell wall. Endotoxins are a naturally occurring biological molecule that readily degrades in sunlight. There are no existing or proposed U.S. standards or limits for endotoxins in drinking water since the human body can handle significant amounts of endotoxins. The human digestive system literally contains hundreds of thousands of endotoxins.

Fortunately, there was a local independent microbial laboratory, Nelson Labs, in Salt Lake City that had much information and experience with endotoxin analysis. Dr. Jerry Nelson from Nelson Labs concluded that Snomax posed no risk to human health or the environment. He believes that endotoxins introduced into the environment from the use of Snomax

are indistinguishable from other naturally occurring endotoxins and that the product does not appear to be harmful to humans or the environment. This conclusion seems to confirm real life findings since Snomax has been used for more than 10 years along the Wasatch Back with no reported impacts to human health or the environment.

SLOC and DWQ decided to develop and implement an endotoxin and nutrient monitoring program for the Soldier Hollow area, including the downstream Deer Creek Reservoir (which is a drinking water source), to confirm the studies and observations described above. This monitoring program began in September 2001 and continued until June 2002.

Three sample sites were selected. The Solider Hollow holding pond was designated as the upstream background sample site with the Soldier Hollow Creek (below the Chalet) as the downstream sample site. The Provo River Bridge sample was collected to determine the levels of endotoxin in surface water associated with agricultural/grazing land uses in the area. Table 2-9 presents the results of the Endotoxin Testing Program at Soldier Hollow Park. It should be noted that several monthly water sampling events were missed by either SLOC or DWQ.

The data appears to be rather erratic. However, the concentrations never exceeded 300 EU/mL, which is considered very low, and not a threat to human health. Note that a large (6,500 cubic yard) artificial snow pile made with Snomax was located within 100 feet of the Soldier Hollow creek sample site. The snow pile did not completely melt away until July, however it appears there was no impact to the creek from the snow pile containing Snomax.

2.3 *SOLID AND HAZARDOUS WASTE*

SLOC's Environmental Function and Waste, Recycling, Cleaning and Snow Removal (WRCS) Function completed an Integrated Solid Waste Management Plan for the Salt Lake 2002 Olympic and Paralympic Winter Games in January 2002 and submitted the plan to the Utah Department of Environmental Quality, Division of Solid and Hazardous Waste (DSHW) for review and comment. This document is included in Appendix C. The document presents SLOC's "Zero Waste Goal" and discusses the different types of waste management available to SLOC as well as anticipated waste sources, types and amounts. The plan outlines the following SLOC waste programs:

- Source Reduction
- Source Separation and Temporary Storage

Table 2-9
Results of Endotoxin Testing
Soldier Hollow

| SAMPLE LOCATION | SAMPLE DATE | DETECTED ENDOTOXIN (EU/mL) |
|---|--------------------------------|----------------------------------|
| Bag #1 of Snomax | 9/5/01 | 134 |
| Bag # 2 of Snowmax | 9/5/01 | 70 |
| Bag #3 of Snowmax | 9/5/01 | 141 |
| SH Midway Irrigation District Snowmaking water | 9/5/01 | 63 |
| SH Holding Pond | 9/5/01 | 177 |
| SH @ Heber Creeper Crossing | 9/5/01 | 93 |
| Provo River Bridge above Deer Creek Reservoir (DCR) | 9/5/01 | 96 |
| DCR Boat Ramp- Main Use Area | 9/5/01 | 73 |
| DCR Island Beach Boat Ramp | 9/5/01 | 78 |
| Taylorsville Tap Water @ Nelson Lab | 9/5/01 | 3 |
| | | |
| SH Holding Pond | 1/31/02 | 6.1 |
| SH @ Heber Creeper Crossing | 1/29/02 | 53 |
| Provo River Bridge above Deer Creek Reservoir (DCR) | 1/29/02 | 170 |
| | | |
| SH Holding Pond | See 2/28/02 for monthly sample | See 2/28/02 for monthly sample |
| SH @ Heber Creeper Crossing | 2/7/02 | 53 |
| Provo River Bridge above Deer Creek Reservoir (DCR) | 2/7/02 | 65 |
| | | |
| SH Holding Pond | See 2/28/02 for monthly sample | See 2/28/02 for monthly sample |
| SH @ Heber Creeper Crossing | 2/12/02 | 68 |
| Provo River Bridge above Deer Creek Reservoir (DCR) | Not sampled | Not sampled |
| | | |
| SH Holding Pond | 2/28/02 | 9.1 |
| SH @ Heber Creeper Crossing | 2/26/02 | 75 |
| Provo River Bridge above Deer Creek Reservoir (DCR) | 2/26/02 | 137 |
| | | |

Table 2-9 (continued)
Results of Endotoxin Testing
Soldier Hollow

| SAMPLE LOCATION | SAMPLE DATE | DETECTED ENDOTOXIN (EU/mL) |
|--|-------------|----------------------------------|
| SH Holding Pond | 3/31/02 | 250 |
| SH @ Heber Creeper Crossing | Not Sampled | Not Sampled |
| Provo River Bridge above Deer Creek Reservoir (DCR) | Not Sampled | Not Sampled |
| | | |
| SH Holding Pond | 5/16/02 | 250 |
| SH @ Heber Creeper Crossing | 5/16/02 | 64 |
| Provo River Bridge above Deer Creek Reservoir (DCR) | 5/16/02 | 230 |
| | | |
| SH Holding Pond | 6/6/02 | 280 |
| SH @ Heber Creeper Crossing | 6/6/02 | 180 |
| Provo River Bridge above Deer Creek Reservoir (DCR) | 6/6/02 | 190 |
| | | |
| | | |
| Last Updated 6/24/02 | | |

- Waste Collection and Transfer
- Waste Recycling and Composting
- Landfilling
- Public Participation and Education
- Compliance and Oversight

SLOC's goal was to recover (recycle) at least 85% of the total waste generated leaving only 15% of the waste to be landfilled. SLOC realized that the goal may not be achievable, but set it as a standard for future Olympic cities. In 1996, Atlanta reported an overall recovery rate of 50%. In 2000, Sydney reported a recovery rate of approximately 70%.

Waste was collected from 10 competition venues, 6 non-competition venues, and 21 Park-n-Ride facilities. Wastes were generated on the field-of-play, back-of house, front-of-house, within the secured perimeter and outside the secured perimeter. The anticipated waste types included recyclables, compostables, rejects, special, universal, hazardous, infectious and construction/demolition wastes.

SLOC conducted a test speed skating event at the Utah Olympic Oval in November 2001. As part of this test event, a 10% random sampling of 30 cubic yards of event generated waste was collected and analyzed by weight for various recyclable, compostable, and reject materials. The total sample weighed 245 pounds, and the results are summarized in Table 2-10.

Table 2-10 Test Event Waste Composition by Weight

| Recyclable – 40.5% | Compostable – 50.6% | Reject – 8.9% |
|-----------------------------|----------------------------|-------------------------|
| Corrugated Paper – 15.2% | Compostable Paper – 17.1% | Non-Bulky (<30") – 6.3% |
| Plastic Film – 6.3% | Food Waste – 14.8% | Textiles – 2.6% |
| Mixed Plastics – 5.0% | Wood – 12.2% | Bulky (>30") – 0.0% |
| Mixed Office Paper – 4.9% | Liquids – 6.5% | Ceramics – 0.0% |
| PET Bottles – 3.9% | | |
| Aluminum Cans – 2.1% | | Special – 0.0% |
| Newsprint – 1.7% | | Universal – 0.0% |
| Other Ferrous – 1.5% | | Hazardous – 0.0% |
| Ferrous Cans – 0.0% | | Infectious – 0.0% |
| Bulky Ferrous (>30") – 0.0% | | |
| Aluminum Foil – 0.0% | | |
| Other Aluminum – 0.0% | | |
| Glass – 0.0% | | |

This test suggested that more than 90% of Olympic venue waste could potentially be recovered and less than 10% could be landfilled.

SLOC used a two bin waste recovery system in all front-of-house areas. Discarded plastic and aluminum cans went into one bin with all other waste going into the second bin. More than 8,500 bins were distributed throughout the Olympic theater. Both types of bins were 44 gallon plastic with domed lids to prevent snow buildup. Each bin was “wrapped” with a specially designed sticker that graphically indicated what materials belonged in each container. The bins had color coded liners for easy identification during waste processing.

WRCS implemented a source separation system back-of-house for cardboard, mixed paper, spent food, glass, and other special wastes. SLOC hired 7 waste haulers to collect Olympic related wastes and haul them to a wet Materials Recovery Facility (MRF) operated by Green Valley Recycle and Compost in conjunction with Weyerhaeuser Recycling. The MRF was designed to process between 100-200 tons of mixed waste or source separated materials per day. The MRF recovered the recyclable products and the remaining waste (mostly food and contaminated paper) was mixed with wood chips for bulking and then composted at Wasatch Energy Systems in Davis County. Reject wastes were sent to the Salt Lake

Valley Solid Waste Management Facility. Weyerhaeuser brokered all the recyclables. Appendix C, Table C-1 lists the potential characteristic wastes generated during the Olympics. Appendix C, Figure C-1 is the waste management flow chart developed for the Olympics.

WRCS was responsible for tracking tons of waste generated as well as costs associated with the waste management program. Appendix C, Table C-2 presents the tons of waste generated by venues during the 17 days of the Olympics as well as the associated hauling costs. Appendix C, Table C-3 presents the tons of waste generated by venue during the Paralympics. These tables do not include waste numbers from the Park-n-Ride lots or the 10 days of set-up waste that was collected and processed prior to the Games.

Table 2-11 summarizes the totals of waste generated from Olympics, Paralympics, the Park-n-Ride lots and the 10 days of set up wastes.

Table 2-11 *Summary of Waste Generation in Tons*

| | |
|--|---------|
| Venues during the Olympics | 912.13 |
| Venues during the Paralympics | 183.69 |
| Park-n-Rides and 10 days of set up waste | 502.18 |
| Total Waste Generated | 1597.90 |

Table 2-12 shows waste management totals for the Games that are discussed in the final Materials Recovery Report included in Appendix C. The numbers were updated for this report and include total tons received from January 28, 2002 to February 25, 2002 plus approximately 10 days of pre-Games set up waste and final materials moved from the Green Valley MRF to Wasatch Energy Systems post-Games.

Table 2-12 Waste Management Totals in Tons

| | | |
|---|------|---|
| OCC recycled | | 129 |
| Plastic recycled | | 88 |
| Aluminum recycled | | 4 |
| Other metal recycled | | 10 |
| Processed waste sent to Wasatch Energy compost site | 1262 | 883 compostable 379 Reject to landfill |
| Scrap wood sent to Wasatch Energy compost site | | 54 |
| Rejects from MRF sent to landfill | | 51 |
| Total Waste Generated | | 1598 |
| Expected Recovery Rate | | 73% |

After the Olympics, the Environment Function provided the Venue Managers with a table (Table 2-13) of waste management options for items encountered during tear down and reclamation.

The monitoring results for waste management, and the lower than expected recovery rate, indicate a definite problem with the efficiency of the Materials Recovery Facility (MRF). Despite assurances from the owner/operator, Green Valley, that the facility was fully functional and could handle waste separation and recycling, a large amount of relatively unsorted waste reached the Wasatch Energy compost facility and is currently awaiting sorting. Green Valley estimates that 30% (by weight) of this material is unsuitable for composting. The compost piles will be screened this spring and approximately 379 tons of material will be landfilled in Davis County.

A separate Range Management Plan for the Soldier Hollow Biathlon Range was developed to address management of lead waste from the shooting range. The plan is included in Appendix C.

The results of the waste monitoring program indicate the recycling goal of 85% was ambitious as expected. However, the anticipated actual recovery rate of 73% still shows a continued improvement at successive Olympics. The pre-Games waste identification and planning resulted in smooth waste management practices for SLOC from point of generation up until processing at the MRF. If the MRF had not encountered processing problems, the recovery/recycling rate would have been much higher, potentially as high as 92%.

Table 2-13
Disposal of Tear Down Recyclables and Wastes

| MATERIAL | WASTE MANAGEMENT OPTIONS |
|--|--|
| Signage | <ul style="list-style-type: none"> • Coroplast signs should be stacked on pallets, banded and transported back to the MDC in the venue recovery trucks. Logistics has arranged for a company to pick up and recycle the signs from the MDC. • Venue Signage Managers are coordinating removal and transport of rolled steel sign frames A, B, C to the warehouse. • J & K with concrete ballasts will be removed and transported by a contractor for recycling. |
| Concrete flag bases and other concrete demolition waste | <p>Yesco is responsible for removal and disposal of unwanted concrete flag bases. Site Managers are responsible for disposal of other concrete demolition waste. This material can be hauled to Bland Recycling at 2100 South, 6451 West. Hauler to be determined by Site Manager. The contact for Bland Recycling is Mr. Boe Bland (243-1183). The following recycling rates apply:</p> <p style="padding-left: 40px;">\$15 for each five foot diameter concrete flag base \$3.50 per cubic yard for other concrete demolition waste.</p> |
| LOOK Towers | Yesco is responsible for dismantling and disposing of LOOK Towers. |
| Full sheets or boards of lumber in good condition | Stack and band on venue. Habitat for Humanity (HH) or other entity will come to each venue and pick up for re-use. Venue Development to provide schedule for HH pick-up. |
| Glass/wooden doors and miscellaneous construction materials (paints, nails, hardware) | Environment is investigating donation of these materials to Habitat for Humanity. |
| General Construction Waste | Site Manager to contract with a hauler. General construction and office waste should be placed in a dumpster labeled "Landfill". The cost to landfill material is \$22 – 25 per ton. |
| Untreated, unpainted , unoiled or unstained wood | All scraps of appropriate wood can be segregated in a dumpster marked "Wood for Composting" and hauled to the Salt Lake Valley landfill at 6030 West California Ave. for chipping or composting at a rate of \$16/ton. |
| Treated, painted, oiled or stained wood | Dispose of in "Landfill" dumpster. |
| Cardboard | Cardboard can be recycled by Weyerhaeuser if separated from other wastes and kept clean. If there is not a lot of cardboard on site, store in dry place, stack and band for pick up by venue logistics truck that will deliver directly to Weyerhaeuser or to MDC as determined by Logistics. Venue Development responsible for scheduling pick ups. If there is a lot of cardboard, contact Mike Jenkins (215-6068) to arrange for disposal. |

Table 2-13 (continued)
Disposal of Tear Down Recyclables and Wastes

| MATERIAL | WASTE MANAGEMENT OPTIONS | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------|---|-------|--------------|--------|--------------|------------------|--------------|---------------------------|--------------|------------------------|--------------|------------|--------------|----------------------------|--------------|---------------------|--------------|---------|--------------|--------------------|--------------|---------------|--------------|------|--------------|--------------|--------------|
| Metals | Metro Group can stage one or two 30 yard dumpsters at each venue and pick up for recycling. For venues located close to Salt Lake City, there is no cost for the dumpster or recycling. The cost for venues along the Wasatch Back and in Provo/Ogden is \$100 each time the company services the dumpster. The metals can be separated (steel and steel cable, aluminum and insulated wire) or combined in one bin. If combined, the salvage value is reduced since Metro Group will perform the sorting. The facility is located at 401 W, 900 S in Salt Lake City. Contact is Dan Floyd (328-2051 or cell phone at 301-1148). | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carpets | Modern Display will be removing carpets for re-use. Carpet scraps can be placed in "Landfill" dumpster for disposal. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oily Wastes | Each venue should have a 55 gallon plastic drum that was provided by Environment for containment of oily spill clean up materials. Environment will arrange for TW Company to pick up wastes per a schedule provided by Venue Development. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WRCS Special Wastes | <p>WRCS crews have been instructed to dispose of these materials at the Household Hazardous Waste (HHW) drop-off which is located at the Salt Lake Valley Solid Waste Facility at 6030 West California Avenue (1400 S). For a small fee, they will accept venue special, hazardous, and universal wastes as long as each venue does not dispose of more than 2,200 pounds. The facility is open Monday through Saturday from 8 AM to 4 PM. Volunteers or staff can drop things off from their own vehicles. Ensure deliveries are secure and won't leak. Fluorescent tubes should be unbroken and in a closed box or container. Label all waste containers with their content and accumulation dates. HHW requires payment at the time of drop-off. Contact at HHW is Les Brooks (cell phone 541-4078). The following prices:</p> <table> <tr><td>Paint</td><td>\$0.35 / lb.</td></tr> <tr><td>Toxics</td><td>\$0.35 / lb.</td></tr> <tr><td>Fuels (high BTU)</td><td>\$0.25 / lb.</td></tr> <tr><td>Oil without contamination</td><td>\$0.15 / lb.</td></tr> <tr><td>Oil with contamination</td><td>\$0.35 / lb.</td></tr> <tr><td>Corrosives</td><td>\$2.00 / lb.</td></tr> <tr><td>Adhesives and 2-part epoxy</td><td>\$2.00 / lb.</td></tr> <tr><td>Oxidizers/Reactives</td><td>\$5.00 / lb.</td></tr> <tr><td>Mercury</td><td>\$9.00 / lb.</td></tr> <tr><td>Fluorescent Lights</td><td>\$0.15 / ft.</td></tr> <tr><td>Halogen bulbs</td><td>\$0.30 / ea.</td></tr> <tr><td>PCBs</td><td>\$0.75 / lb.</td></tr> <tr><td>Aerosol Cans</td><td>\$0.75 / lb.</td></tr> </table> | Paint | \$0.35 / lb. | Toxics | \$0.35 / lb. | Fuels (high BTU) | \$0.25 / lb. | Oil without contamination | \$0.15 / lb. | Oil with contamination | \$0.35 / lb. | Corrosives | \$2.00 / lb. | Adhesives and 2-part epoxy | \$2.00 / lb. | Oxidizers/Reactives | \$5.00 / lb. | Mercury | \$9.00 / lb. | Fluorescent Lights | \$0.15 / ft. | Halogen bulbs | \$0.30 / ea. | PCBs | \$0.75 / lb. | Aerosol Cans | \$0.75 / lb. |
| Paint | \$0.35 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Toxics | \$0.35 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fuels (high BTU) | \$0.25 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oil without contamination | \$0.15 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oil with contamination | \$0.35 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Corrosives | \$2.00 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Adhesives and 2-part epoxy | \$2.00 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oxidizers/Reactives | \$5.00 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mercury | \$9.00 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fluorescent Lights | \$0.15 / ft. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Halogen bulbs | \$0.30 / ea. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PCBs | \$0.75 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aerosol Cans | \$0.75 / lb. | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 2-13 (continued)
Disposal of Tear Down Recyclables and Wastes

| MATERIAL | WASTE MANAGEMENT OPTIONS |
|---|---|
| Construction drawings and all other large quantities of paper wastes | On venue, the Site Manager to establish a collection location for paper to be recycled. Other areas to be determined. |
| Portapath | Clean and send back to the MDC via venue logistics trucks. |
| Fencing | Back of house fencing will be removed by National Fencing. Front of house fencing to be removed by LOOK contractor. |

There were 10 competition venues and two non-competition venues (Rice Eccles Stadium and Olympic Medals Plaza) that utilized portable restrooms during the Games. There were also 6 support venues (practice ice sheets, etc.) and 10 Utah Department of Transportation and Utah Transit Authority Park-n-Ride sites that used port-a-lets during the Games.

The estimated wastewater flow used for planning purposes prior to the Olympics was 1,503,000 million gallons over the 17 days. This was based on the estimated maximum number of people attending each event. The spectator capacity for each venue is listed in Table 2-1. Utah's Mass Gathering Regulations specify the number of port-a-lets required at an event based on the peak crowd, average time at the gathering and whether alcohol was served (increases number of required toilets by 40%). Generally it worked out to approximately one port-a-let for every 26 people. The maximum total spectators and staff estimated on a given day throughout the Olympic theater was 222,000. Table 2-14 lists the estimated wastewater flows to various plants within the Olympic theater. These numbers were calculated prior to the Olympics and were used for permitting and planning purposes.

Table 2-14 *Estimated Portable Wastewater Flows to Various Treatment Plants*

| Venue | Treatment Plant | Flow Delivered (gallons) |
|--|-------------------|--------------------------|
| Deer Valley Resort Park City Mountain Resort Park City Soldier Hollow Park | Heber City | 490,000 |
| Snowbasin | Snowbasin | 53,000 |
| Peaks Ice Arena | Provo | 19,000 |
| Salt Lake Ice Center Rice Eccles Stadium Olympic Medals Plaza Olympic Village | Salt Lake City | 216,000 |
| Utah Olympic Park E Center Park City Mountain Resort Park City | Central Valley | 450,000 |
| Utah Olympic Oval | South Valley | 72,000 |
| Peaks Ice Arena | Timpanogos | 92,000 |
| | Snyderville Basin | None |
| Snowbasin Ice Sheet at Ogden | Central Weber | 183,000 |
| Total | | 1,503,000 |

Table 2-15 shows the actual wastewater flow to the various plants. The results of the wastewater monitoring indicated that the actual wastewater generated from the portable units was only about one-third (1/3) of the projected wastewater flow.

Table 2-15 Actual Total Portable Wastewater Flows to Various Treatment Plants

| Venue | Treatment Plant | Flow Delivered (gallons) |
|---|-------------------|--------------------------|
| Utah Olympic Park Deer Valley Resort Park City Mountain Resort Soldier Hollow Park | Heber City | 215,000 |
| Snowbasin | Snowbasin | 53,000 |
| Peaks Ice Arena | Provo | 19,000 |
| Salt Lake Ice Center Ice Sheet at Ogden Rice Eccles Stadium Olympic Medals Plaza | Salt Lake City | 266,000 |
| E Center Utah Olympic Oval | Central Valley | 53,000 |
| | South Valley | None |
| | Timpanogos | None |
| | Snyderville Basin | None |
| | Central Weber | None |
| Total | | 606,000 |

The Utah Division of Water Quality estimated that the port-a-let wastewater comprised 90% of the actual wastewater directly associated with Olympic activities during the Games. The Salt Lake City Public Utilities monitored the amount of influent to its Salt Lake City wastewater treatment plant. Figure D-1 in Appendix D shows that the average winter influent flow in 2000-2001 was approximately 32.4 millions gallons per day while the flow for the winter of 2001-2002 was 32 million gallons per day. The contribution of Olympic related port-a-let wastewater to the POTW was insignificant relative to the overall wastewater generated in the Salt Lake area.

A team of five sanitation companies grouped together to form "A Company 02 LLC," which was the company that provided the portable sanitary services to SLOC. "A Company" provided the following sanitation equipment to SLOC:

- 2,446 portable restrooms
- 31 portable restroom trailers
- 83 handwash stations
- 94 holding tanks

The following operational equipment was also proved:

- 17 service trucks
- 8 pump trucks
- 8 foreman trucks
- 8 restroom trailer tech trucks
- 8 management trucks
- 5 delivery trucks
- 4 tankers

The “A Company” developed a monitoring manifest for the portable toilet waste haulers to use that listed permit information, hauling company information, source of the waste (venue name), gallons discharged, date of pumping, time of pumping and truck license number. The name of the designated Publicly Operated Treatment Works (POTW) was listed at the top of the manifest and the hauler had to certify by signature that the discharged contents was domestic waste only. A copy of the monitoring manifest appears in Appendix D. The POTW verified on the manifest the date and time the shipment arrived at the treatment plant. The manifests documented the amount of waste generated from the portable sanitary units.

No alcohols, glycols or methanols were used in the port-a-lets. Calcium chloride was used in the units along the Wasatch Back to prevent freezing. Salt was used in the units in Salt Lake City and Ogden. Biodegradable deodorant additives were used at the Peaks Ice Arena in Provo because the units were in tents. There were only two small spills associated with the portable wastewater program and these were cleaned up very quickly with no resulting environmental impact (Appendix H, Incident Tracking).

In conversations with the various POTW's, several problems were noted during and after the Games. The Heber City POTW stated that 2 to 3 weeks after the wastewater arrived at the plant, the 8 acre aerated lagoon that accepted the waste had a strong sewage odor. This usually does not occur. The Heber POTW also noted that some trash, such as hand warmer packaging, accompanied the wastewater. The POTW has a grinder but no screen, therefore the trash ended up in the lagoon. The trash also made it difficult to unload the wastewater from the large tanker trucks into the POTW. The trash plugged the discharge lines on the tanker trucks so several times the smaller suction trucks were used to unload the tankers to the POTW.

A unique, though minor amount of wastewater generated during the Games came from the four Kodak processing units. Kodak was responsible for monitoring its photographic processing effluent from the following four venues: Olympic Village, Main Media Center, Soldier Hollow and Snowbasin. Kodak used a silver recovery process to treat its effluent prior to discharge to a POTW. The treatment process is described in Appendix D, Kodak Photographic Effluent Characteristics, Proposed Processing Solution Management.

Kodak estimated that it would discharge the following amounts and types of effluents from these venues:

Table 2-16 *Kodak Effluent - Soldier Hollow and Snowbasin*

| Remote Venue | Estimated Average Daily Volume |
|----------------|--------------------------------|
| Snowbasin | Less than 2 gallons |
| Soldier Hollow | Less than 6 gallons |

| Parameter | Expected Range (ppm) |
|------------------------------|----------------------|
| BOD ₅ | 6000 to 6500 |
| COD | 70,000 to 80,000 |
| Silver | Less than 5* |
| Ammonia | 12,000 to 16,000 |
| Total Dissolved Solids (TDS) | 50,000 to 55,000 |
| Iron | 1200 to 3000* |
| pH | 7 to 9 |
| Detergents ^c | None to 90 |
| Temperature | Less than 100°F |
| Oil and Grease | None |

* After efficient silver recovery using Academy EPS-8 Silver Recovery Unit

Table 2-17 *Kodak Effluent - Main Media Center*

| Type of Solution | Estimated Average Daily Volume |
|---|-----------------------------------|
| Process E-6AR | 200 gallons |
| Process E-6 AR Wash Waters | 1500 to 3050 ^a gallons |
| Minilab effluent within the KIC | 80 gallons |
| Minilab effluent outside the KIC from agencies within the MMC (not controlled by Kodak) | 60 gallons |

| Parameter | Range (ppm) | Expected Average (ppm) |
|------------------------------|--|--------------------------|
| BOD ₅ | 730 ^a to 5500 ^b | 960 |
| COD | 2200 ^a to 50,000 ^b | 4480 |
| Silver | Less than 5 ^c | Less than 5 ^c |
| Ammonia | 315 ^a to 9000 ^b | 730 |
| Total Dissolved Solids (TDS) | 12,800 ^a to 40,000 ^b | 14,100 |
| Iron | 216 ^a to 1800 ^b | 291 |
| PH | 7 to 9 | |
| Detergents | None to 90 | |
| Temperature | less than 100°F | |
| Oil and Grease | None | |

^a100% E-6 effluent with processors running with every other rack at full capacity, with water saver devices

^b100% minilab effluent

^cafter efficient, on-site silver recovery

Table 2-18 Kodak Effluent - Olympic Village

At the Athlete's Village there would be an estimated average of 20-22 gallons per day of photoeffluent discharged with the following characteristics:

| Parameter | Expected Range (ppm) |
|------------------------------|----------------------|
| BOD ₅ | 6000 to 6500 |
| COD | 70,000 to 80,000 |
| Silver | Less than 5* |
| Ammonia | 12,000 to 16,000 |
| Total Dissolved Solids (TDS) | 50,000 to 55,000 |
| Iron | 1100 to 1400 |
| pH | 7 to 9 |
| Detergents | None to 90 |
| Temperature | less than 100°F |
| Oil and Grease | None |

* After efficient silver recovery using Academy SR-1000 Silver Recovery Unit

The monitoring conducted by Kodak showed no analytical anomalies. The silver removal process was successful. The amounts of effluent generated where 30 to 50% less than expected due to the use of digital camera imagery by many participants and patrons of the Games.

There are 8 major potable water districts that supplied water to the Olympic theater along the Wasatch Front and Back. These districts are Salt Lake, Central Utah Water Conservancy, Jordan Valley Water Conservancy, Provo, Park City, Heber, Ogden and Kearns. Water quality monitoring is performed by each district on its own system. *Daphnia magna* toximeters were used as early warning monitors for chemical and/or biological contamination at the Salt Lake, Central Utah Water Conservancy, and Jordan Valley Water Conservancy districts. Chloride residual, pH and bacteria were monitored by all systems at an increased frequency prior to and during the Games. All reservoirs were monitored as well as continuous in-line distribution system monitoring for the Salt Lake City and Park City Districts. No anomalies were reported.

Water consumption was monitored via flow meters at the distribution source. The typical demand per day in the Salt Lake potable water district is approximately 180 million gallons per day (mgd) in the summer months and 50 mgd in the winter months. Appendix E, Figure E-1 compares the water consumption February 8 – 24 from the Salt Lake District for the years 2001 and 2002. The average consumption of potable water for the 17-day period in 2001 was 51.69 mgd compared to 50.78 mgd during the same period in 2002. The actual water demand was slightly down during the Olympics possibly due to a pre-Olympic campaign aimed at water conservation. As part of this, the majority of hotels in downtown Salt Lake City and Park City placed a card on the bed pillow that encouraged patrons to reuse towels and bedding instead of having them washed each day. The message was provided in English, German, Spanish and French.

The Salt Lake Organizing Committee (SLOC), the Utah Energy Office and Leonardo Academy's Cleaner and Greener Program created an Olympics Cleaner and Greener Program to make the Olympics a zero emissions event. This program is described in more detail in the News Release included in Appendix F. The Leonardo Academy is a non-profit organization based in Madison, Wisconsin that works on energy and environmental issues. The Leonardo Academy quantified the projected emissions produced by all forms of energy anticipated to be used during the Games, including transportation, operations, and the torch relay. Donations of emission reduction credits were solicited from local and national companies to offset the projected emissions produced by hosting the Games. The donated credits were then permanently retired so that

they could not be sold or used again, thus working toward the zero emissions goal.

Leonardo Academy's estimates of total incremental emissions of significant air pollutants as a result of the Games are included in Appendix F. Their estimates include the emissions from activities associated with venue construction, test events held prior to the Games, the Torch Relay, the Games themselves, the Paralympic Games and auxiliary SLOC's activities such as office energy use. The estimates took into account energy used for temporary generators, heating of tents and transportation.

Leonardo Academy estimated that 83,500,000 Kwh of additional on-site energy would be consumed as a result of hosting the Games. They estimated 5,900,000 gallons of propane would be used to heat tents. Leonardo Academy calculated 37 million auto and truck vehicle miles traveled (VMT) to and from venues during the Games with the majority of those miles using gasoline. They calculated 2 million bus VMT which was a combination of CNG, diesel and gasoline.

Pacificorp, the local company that provides coal-generated electricity, monitored actual energy usage during the Games. Pacificorp provided that information to TOROC via e-mail after the 2002 Olympic Winter Games. At the time of printing this report, Pacificorp had not received the appropriate authorization to release the actual energy usage to ERM. However, their general conclusion for energy usage was that actual usage was less than the predicated need.

Finally, Table F-1 in Appendix F shows the total estimated air emissions from all energy sources and then lists the savings or offsets provided by Cleaner and Greener sponsor companies and programs. The total emission reductions are listed and indicate that the goal of zero emissions was reached for CO₂, SO₂, NO_x, PM₁₀ and Hg. CO and VOC's were not completely offset due to the lack of reductions or offsets available in the trading market. The data indicates that 42% of VOC emissions were offset and 3% of CO emissions were offset. The backup documentation for the calculation of estimated energy usage is included at the end of Appendix F.

2.7

ECOMOSAIC

Three venues were constructed by SLOC for the 2002 Olympic Winter Games: the Utah Olympic Oval, the Utah Olympic Park and Soldier

Hollow Park. All construction was designed to minimize disturbance of habitats and protect the environment.

Utah Olympic Oval- The \$27 million state-of-the-art Utah Olympic Oval was designed to promote near-perfect speed skating conditions and to leave an enduring environmental legacy. Architects created an innovative design that incorporates the U.S. Green Building Council's new rating system that promotes Leadership in Energy and Environmental Design (LEED). The building received a prestigious LEED award prior to the Olympics. The Oval's design incorporates a unique cable-suspension system that supports the roof. This design required one-third less steel (about 985 tons) than a traditionally constructed building. Moreover, the design positions the roof about 20 feet lower than a conventional roof, reducing the building's volume by nearly 1 million cubic feet, increasing the energy efficiency and allowing the temperature and humidity inside the venue to be more carefully controlled.

Nearly 5 acres of rubber membrane-designed roofing material was installed to reflect heat that would typically be absorbed into the building. Flooring for the venue was made out of recycled materials. The Oval is one of the most energy-efficient arenas in the world, outperforming the U.S. government's Federal Energy Code by about 20%. The refrigeration system is free of ozone-depleting chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) and the zamboni ice resurfacing machines were retrofitted to run on clean-burning natural gas.

Utah Olympic Park- The \$45 million Utah Olympic Park was situated in steep terrain requiring designers to find ways to mitigate the effects of storm water runoff and the resulting erosion on the courses. Two large retention ponds were created to trap storm water and remove sediment before the runoff is returned to the watershed. All storm water channels have been rip-rapped to slow the flow of water and extensive storm water Best Management Practices have been implemented, such as sediment fencing and straw bale placement.

The bobsled track and ski jumps follow the contour of the terrain and were designed to blend into the landscape. More than $\frac{3}{4}$ of the 386 acre Park remains naturally vegetated and serves as habitat for elk, moose, deer, birds and several small mammal species. During construction, disturbed areas were reseeded as soon as possible with native grass species.

The closed refrigeration system at the track uses ammonia instead of ozone-depleting CFC and HCFC gases. A specially designed heat transfer process helps maintain optimum temperatures and reduces energy

consumption. The bobsled track has a \$1 million retractable shading system to protect the course from sun and snow, reducing the energy usage by 25%.

Soldier Hollow Park- A state-wide search was launched to select the site for the cross-country and biathlon venue. Working together with conservationists, athletes, politicians and the public, 12 sites were reviewed with the final selection being the undeveloped Soldier Hollow in Wasatch State Park. The closest contender for the venue was the already existing Mountain Dell golf course. Soldier Hollow was chosen over Mountain Dell due to better snow accumulation, less construction impact to the public and better accessibility during the Games.

Conservationists were very opposed to the Mountain Dell site since it was located in the watershed above Little Dell Reservoir, a drinking water source for Salt Lake City. The watershed was also prime habitat for deer, moose, beaver, bobcats, badgers, ducks and the Bonneville cutthroat trout, Utah state fish. The rare native trout is considered threatened by the U.S. Fish and Wildlife Service. Once the Games were over, Mountain Dell would be restored to a golf course, but the newly constructed Soldier Hollow would remain as a legacy of the Games.

Construction of the Soldier Hollow venue disturbed approximately 0.5 acres of wetlands that were mitigated by establishment of 2.5 acres of constructed wetlands. Irrigation ditches were removed so that natural drainage flows returned to the wetlands. During the past 100 years, the Soldier Hollow area had been used for grazing of cattle and sheep. Construction of the venue improved habitat for birds and small mammals by planting willows, hawthorn, cotton and other native species and discontinued the grazing. Course designers developed a trail system that incorporates numerous loops and crossovers, substantially reducing the footprint of the overall trail system. Native grasses and trees were planted throughout the meadows to offset erosion caused by the track construction.

Snowbasin Road Alignment- The federal government paid \$15 million for construction a new three-mile access road from Trapper's Loop Highway to Snowbasin Ski Resort. The alignment of the road was very controversial with the primary goal to be as environmentally sensitive as possible. Again, diverse stakeholders came together to select the best alignment that would minimized impacts to natural wetlands and preserve critical habitat for moose, deer, Cooper's hawks and flammulated owls. A coalition was formed by SLOC to monitor road construction and associated impacts that included representatives from SLOC, Snowbasin, the U. S. Forest Service, Utah Department of

Transportation, Utah Department of Natural Resources, environmental groups and Stantec (an environmental/engineering consulting company). The coalition routinely met to review construction progress/impacts. After construction was completed, the group met monthly to review storm water Best Management Practices along the road and in a new parking lot. The group noted findings and observations that were recorded by Stantec and given to Snowbasin and SLOC for action.

Hillside Olympic Rings- The Hillside Olympic Rings site was located on the west face of the Twin Peaks on the East Bench of the Salt Lake Valley. Much of the area has been designated and protected as “Open Space” by Salt Lake City. The historic Bonneville Shoreline Trail, a popular hiking and biking trail, transects the site.

The rings icon itself occupied an area of less than 0.5 acres. The entire site including the icon, generator/staging area and access road was approximately 1.5 acres. The land was leased by SLOC from Salt Lake City Corporation, the University of Utah, and four private owners. The icon consisted of the five Olympic rings constructed by a series of 1,800 lights attached to the top of $\frac{3}{4}$ inch metal poles. The rings were operational during the three-week period of the Games from 6 PM to midnight. Electrical power was provided by two temporary 100 Kva generators equipped with mufflers for noise reduction to a sound level of 60 dB (normal conversation).

Construction and operation materials were brought on site by 4-wheel drive vehicles and a snowcat. A hand-held, posthole digger was used to install the metal poles for support of the lights. The poles were inserted 18 inches into the ground. Every precaution was taken to minimize disturbance to soils, rock and vegetation. Consultants performed an Environmental Baseline Assessment over a 5-acre area at the rings site. The baseline study was used to educate contractors on environmental conservation during icon construction and to prepare a post-games reclamation plan to be implemented in the Spring 2002. The Reclamation Plan (and one-page revision to the plan) are included in Appendix G. ERM was contracted to monitor the site for potential environmental impacts and to implement the reclamation plan.

Through the use of stakeholder group involvement SLOC succeeded in constructing three major venues and generally operating with minimal impact to the environment. Early identification of potential environmental issues associated with the venue construction was essential. Many modifications to construction, operation and reclamation plans were made as a result of feedback from stakeholder groups, including regulators. Flexibility and the desire to present “the best

Olympics ever” were key to the overall success of the Games with minimal impact to natural habitats and the environment.

The following environmental program recommendations are provided based on the Olympic experience of ERM's Salt Lake City office and SLOC's Venue Compliance Manager.

1. In order to gain statically significant environmental monitoring data, consider developing and implementing a 5 year monitoring program that begins at least two years prior to the Olympic Games and continues two years after the Olympics. This will allow for the establishment of background data and comparison of non-Olympic related impacts to potential Olympic-related impacts. This would be particularly important for air and water quality monitoring programs.
2. Invite local, provincial and federal regulators to participate in the development and implementation of the monitoring programs. Include results-oriented members of environmental groups to participate in the program development. Meet routinely to discuss progress and results. Develop a cooperative process for resolution of any potential regulatory disputes. Continue this interaction for as long as possible after the Olympics. Perhaps a forum like SLOC's Environmental Advisory Committee would provide the necessary cross-section of experienced stakeholders to participate in these types of discussions.
3. Clearly outline the environmental program goals and objectives. Prepare a Pre-Games report detailing the proposed program and also a post-Games summary report of the results and interpretation of the results. Both reports could be used for transfer-of-knowledge.
4. Develop an internal environmental monitoring training program for staff to convey the importance of the program, its goals and how their contribution and commitment could improve the success of the Games.
5. Rely on proven and in-place waste management and recycling facilities, as opposed to developing a Games-specific program or hiring a "Games-only" contractor to develop a program.

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Appendix A
Air Quality

Appendix B
Water Quality

Appendix C
Solid and Hazardous Waste

Appendix D
Wastewater

Appendix E
Potable Water

Appendix F
Energy Consumption

Appendix G
Ecomosaic